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21. MORPHOLOGY AND IDENTIFICATION OF CLADOCERAN FAUNA OCCURRING IN THE FISH SEED FARM, AAREY, MUMBAI, INDIA[1]

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Introduction

Aquaculture has to play an important role in providing rich proteinaceous food, needed constantly for the ever-increasing human population all over the world. Thus, for intensive production of protein-rich fishes and prawns, it is necessary to provide required zooplanktonic food organisms at an optimum density. Therefore, adoption of basic techniques has been an important consideration by which abundant and sustained production of forageable zooplanktonic food organisms can be produced in high density in a short period of time. The secondary productivity implying production of zooplankton in the water bodies has been always a slow process under natural conditions, and depends upon the pace of primary productivity. However, this natural process may not be obviously suitable for fish and prawn production under fish farm conditions, where quick returns from culture are the essential requirements for commercial viability. Among mass cultured zooplankton in fish nurseries, initial occurrence of Rotifers is essential to provide minute zooplankter to the fish spawn, which has just started feeding. As the spawn grow, they become capable of ingesting slightly larger zooplankter such as Cladocerans and Copepods. Cladocerans are fleshy in nature, highly nutritious and easy to digest; this plays an important role in fish seed production. Shirgur and Indulkar (1987) have emphasized the importance of Cladocerans, which play a significant role as forage organisms for the growing carp fry. It is, therefore, clear that there is a great scope to survey and study the Cladoceran fauna of fish farms so as to understand the species-wise profile among the zooplanktons in fish farm conditions and to assess them on the basis of their mass culture response. The present studies were carried out at a Government Fish Seed Farm, Aarey, Mumbai, on the morphology and identification characters of different Cladoceran species isolated from fortnightly collected zooplankton samples.

Zooplankton samples were collected from the reservoir and fish nursery ponds at the Aarey Fish Seed Farm, Mumbai, for two years at fortnightly intervals, using conical plankton net (120 µm mesh). The collected samples were preserved in isotonic solution (Shirgur 1984). All the samples were examined for qualitative analysis. From the preserved samples, Cladocerans were separated and identified on the basis of standard identification key for Cladocerans (Ward and Wipple 1966). Dr. R.G. Michael of North-Eastern Hill University, Shillong (Meghalaya) confirmed the identification. The distinguishing characters are depicted using Camera Lucida drawings.

From the zooplankton samples collected for two successive years from Government Fish Seed Farm, Aarey, Mumbai, twelve different species of Cladocerans, namely *Ceriodaphnia cornuta* Sars 1886 (Fig. 1), *Moina micrura* (I) Kurz 1874 (Fig. 2), *Moina micrura* (II) (Fig. 3), *Moina dubia* Guerne & Richard 1892 (Fig. 4), *Macrothrix laticornis* Jurine 1820 (Fig. 5), *Kurzia longirostris* Daday 1850 (Fig. 6), *Alona rectangula* Sars 1862 (Fig. 7), *Alona pulchella* King 1853 (Fig. 8), *Chydorus sphaericus* Muller (1785) (Fig. 9), *Bosminopsis deitersi* Richard 1895 (Fig. 10), *Diaphanosoma excisum* (I) Sars 1885 (Fig. 11) and *Diaphanosoma excisum* (II) Sars var Stingling Jenkin 1934 (Fig. 12) were identified. All these Cladocerans belonged to common taxa (Phylum: Arthropoda; Class: Crustacea; Superorder: Diplostraca; Order: Cladocera; Suborder: Eucladocera), as per the classification adopted from Biswas (1971). Ten species belong to one common Superfamily – Chydoridae and four different

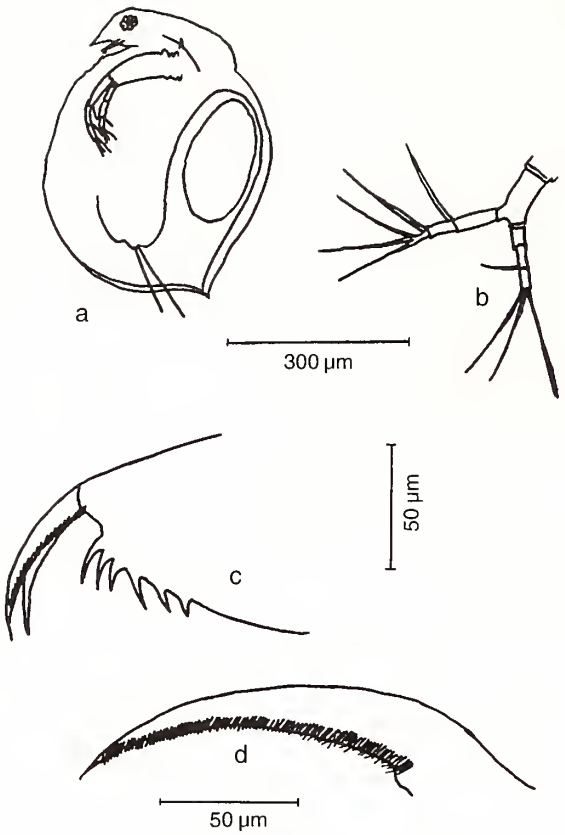

Fig. 1: *Ceriodaphnia cornuta* Sars 1886
a. Parthenogenetic Female, b. Antenna, c. Post abdomen, d. Claw

Families. The remaining two species, *Diaphanosoma excisum* (I) and *D. excisum* (II), belong to the Superfamily Sidoidae and Family – Sididae.

Morphology and distinguishing features of the twelve Cladoceran species are given as below:

1. ***Ceriodaphnia cornuta* Sars 1886** (Fig. 1)

Size range: 300-450 mm; fornix with thorn at mid region, above antenna; smooth bristles present at coxal region of antenna (Hoff 1943; Green 1962; Frey 1967).

2. ***Moina micrura* Kurz 1874 (1)** (Fig. 2)

Size range: 500-600 mm; post-abdominal spines less than eight; supraocular depression absent; pectin on the post-abdomen claw very weak; males with long antennules (Hoff 1943; Ward and Wipple 1966; Michael 1973).

3. ***Moina micrura* (II)** (Fig. 3)

Size range: 700-850 mm; large variety as compared to *Moina micrura* (1); slight supraocular depression present.

4. ***Moina dubia* Guerne & Richard 1892** (Fig. 4)

Size range: 700-900 mm; only stout spines present on proximal region, 6-7 small spines occur separated by solitary stout spines at regular intervals on distal region of stout ventral margin of carapace (Rey and Jean 1968; Biswas 1971).

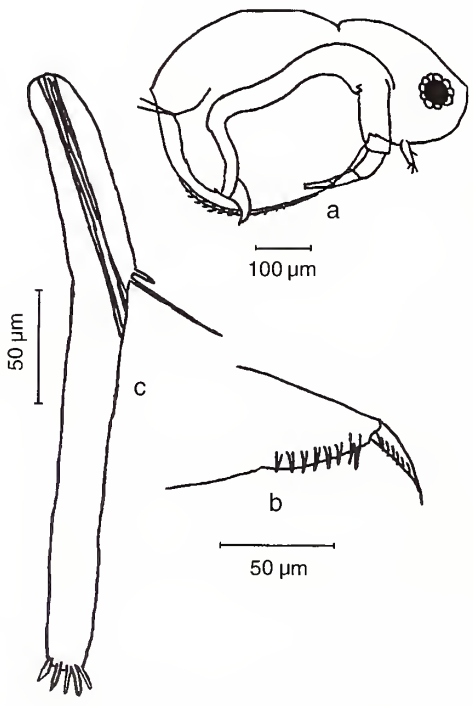

Fig. 2: *Moina micrura* Kurz 1874 (I)
a. Parthenogenetic Female, b. Post abdomen, c. Male antennule

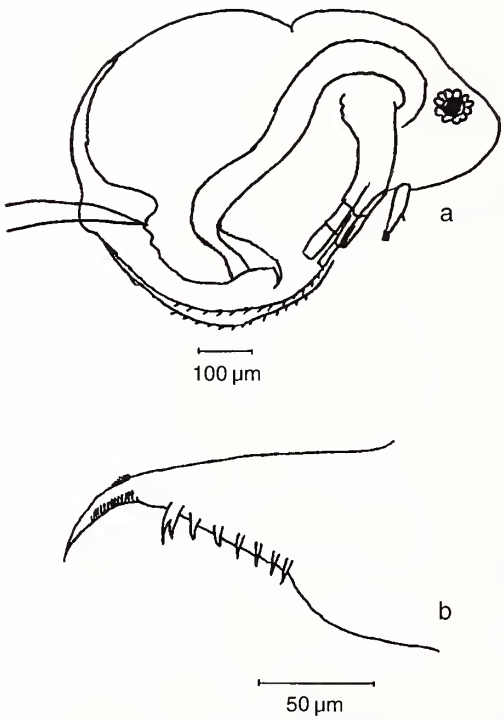

Fig. 3: *Moina micrura* (II)
a. Parthenogenetic Female, b. Post abdomen

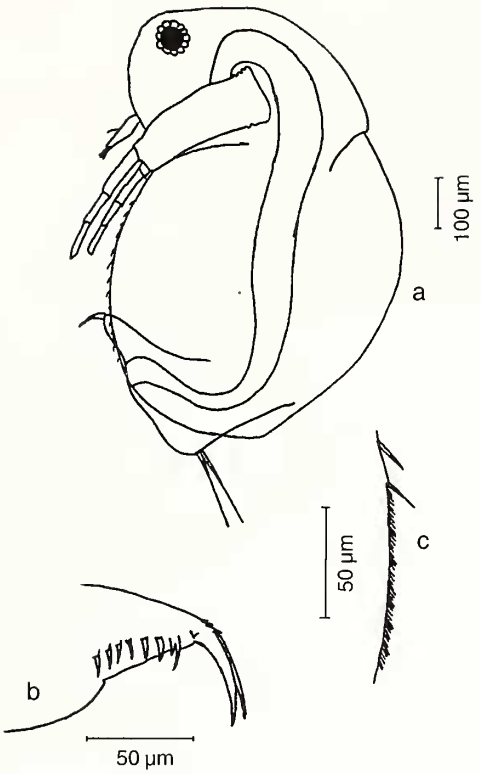

Fig. 4: *Moina dubia* Guerne & Richard 1892
a. Parthenogenetic Female, b. Post abdomen,
c. Posteroventral margin of valve

5. ***Macrothrix laticornis* Jurine 1820** (Fig. 5)

Size range: 500-700 mm; post-abdomen not bilobed; head evenly rounded; labrum with large triangular process (Ward and Wipple 1966).

6. ***Kurzia longirostris* Daday 1898** (Fig. 6)

Size range: 600-700 mm; post-abdomen long with 14 strong marginal spines; length of antennules up to mid-distance of rostrum, sensory bristles at the tip just reach the tip of rostrum (Green 1962; Rey and Jean 1968).

7. ***Alona rectangula* Sars 1862** (Fig. 7)

Size range: 350-450 mm; body ventrally arched, valves striated, reticulated or ventral margin slightly convex; post-abdomen short, slightly elongated towards apex, angle rounded with 8 to 9 marginal denticles or bundles of setae and about as many fascicles, distal ones long enough to project beyond the margin of post-abdomen (Ward and Wipple 1966; Biswas 1971).

8. ***Alona pulchella* King 1853** (Fig. 8)

Size range: 350-450 mm; body oval shaped; reticulation absent on valves; antennules with eight sensory bristles at apex; post-anal margin merges smoothly with anal concavity (Rey and Jean 1968).

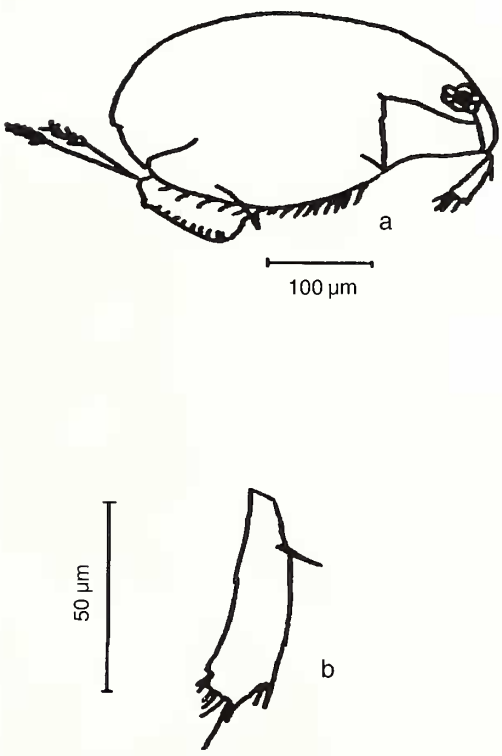

Fig. 5: *Macrothrix laticornis* Jurine 1820
a. Parthenogenetic Female, b. Antennule

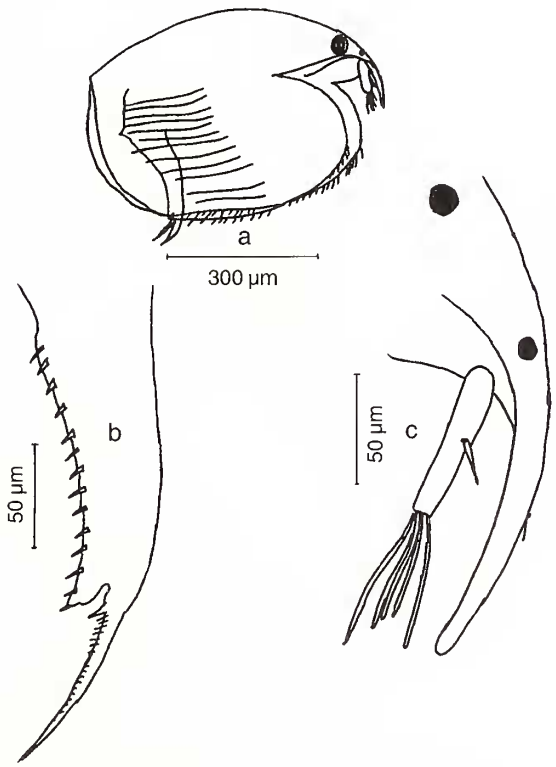

Fig. 6: *Kurzia longirostris* Daday 1898
a. Parthenogenetic Female, b. Post abdomen,
c. Lateral view of head

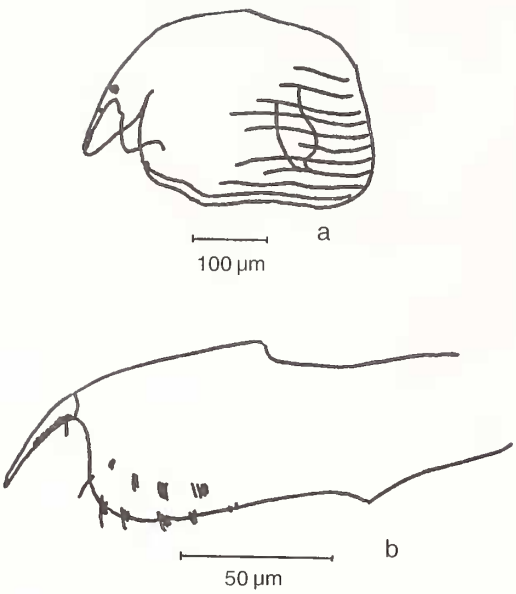

Fig. 7: *Alona rectangula* Sars 1862
a. Parthenogenetic Female, b. Post abdomen

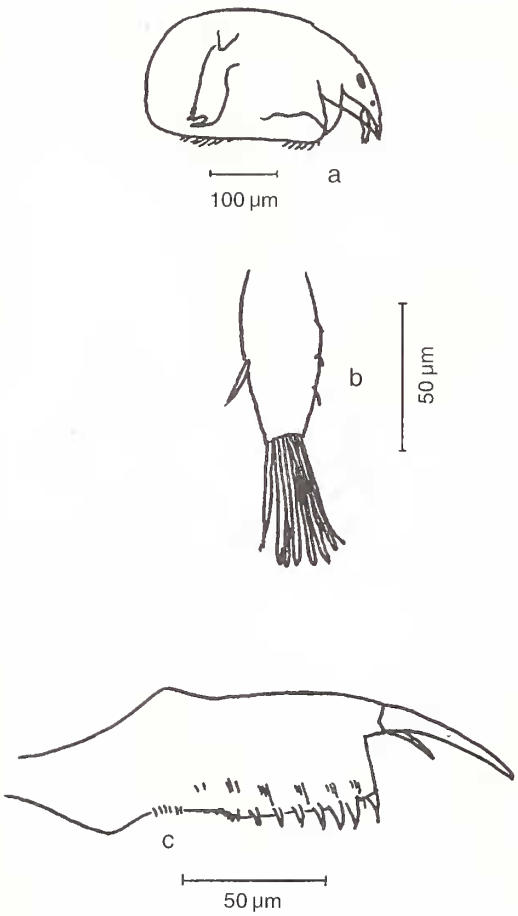

Fig. 8: *Alona pulchella* King 1853
a. Parthenogenetic Female, b. Antennule, c. Post abdomen

9. ***Chydorus sphaericus* Muller 1785** (Fig. 9)

Size range: 300-500 mm; body completely enclosed by shell and head shield; head shield projects over base of antennules as rostrum and laterally over bases of antennae as fornices; antennules not extending beyond tip of rostrum; all olfactory setae at end of antennules; antennular rami three - jointed with setae formula 0-3 / 0-1-3; post-abdomen with 8-9 teeth or denticles along margin, claw small, proximal basal spine very minute (Ward and Wipple 1966; Rey and Jean 1968).

10. ***Bosminopsis deitersi* Richard 1895** (Fig. 10)

Size range: 300-370 mm; antennules united at base, diverging at apex, numerous long straggling olfactory setae on ventral side; post-abdomen tapering to point of claws, one large spine near claw and several minute spinules anterior to it; four small and one large (last) denticles at ventro-posterior margin of carapace (Ray and Jean 1968).

11. ***Diaphanosoma excisum* 1885 (I)** (Fig. 11)

Size range: 700-900 mm; 7 to 12 spines at postero-ventral angle of carapace; hairs on side of post-abdomen absent;

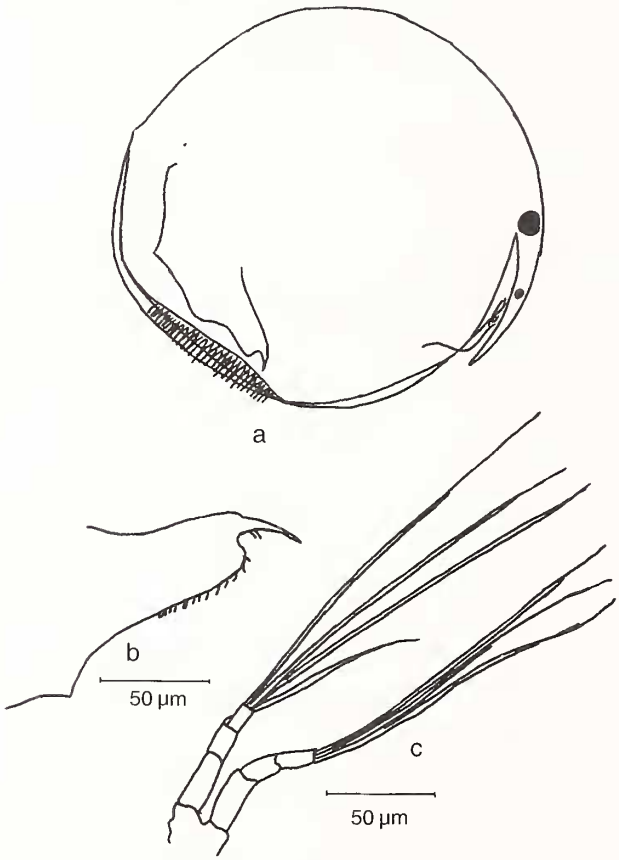

Fig. 9: *Chydorus sphaericus* (O.F. Muller 1785)
a. Parthenogenetic Female, b. Post abdomen, c. Antenna

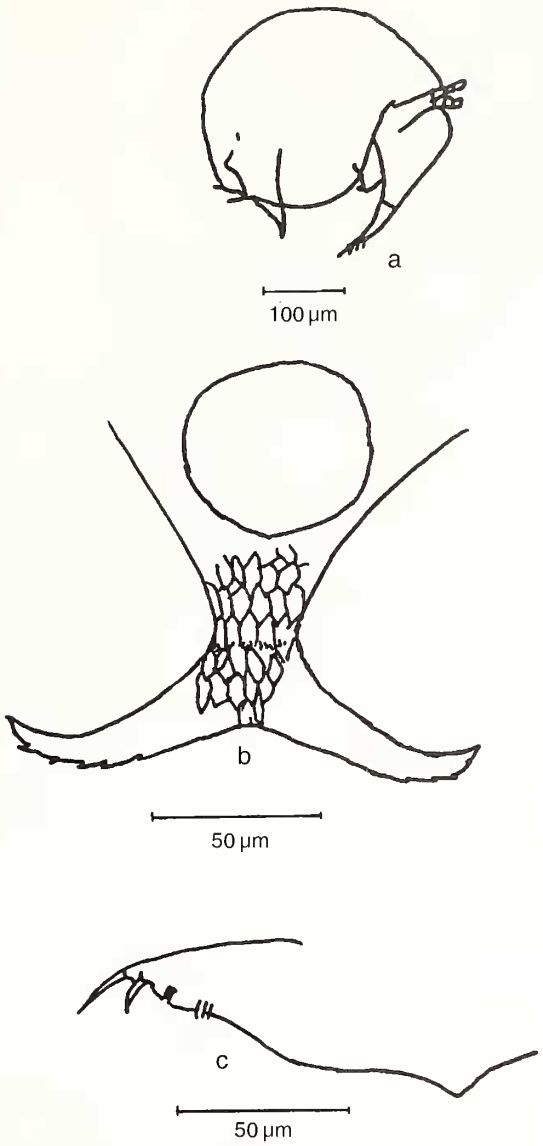

Fig. 10: *Bosminopsis deitersi* Richard 1895
a. Parthenogenetic Female, b. Dorsal view of antennules, c. Post abdomen

antennae short, not more than one third of body length (Biswas 1971).

12. ***Diaphanosoma excisum* (II) Sars var. Stingling Jenkin 1934** (Fig. 12)

Size range: 700-900 mm; antenna long, reaching posterior border of shell, the number and pattern of teeth on postero-ventral margin of carapace differ from the above variety (Biswas 1971).

Among the identified Cladocerans, *Moina micrura* Kurz 1874 is mentioned as *M. micrura* (I) which is a smaller variety. The second variety is mentioned as *M. micrura* (II), which is larger in size and also in respect of its constant size and

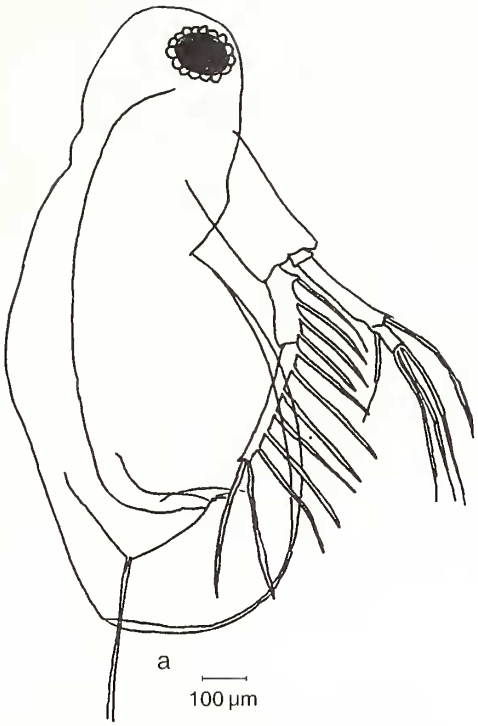

Fig. 11: *Diaphanosoma excisum* Sars 1885 (I)
a. Parthenogenetic Female

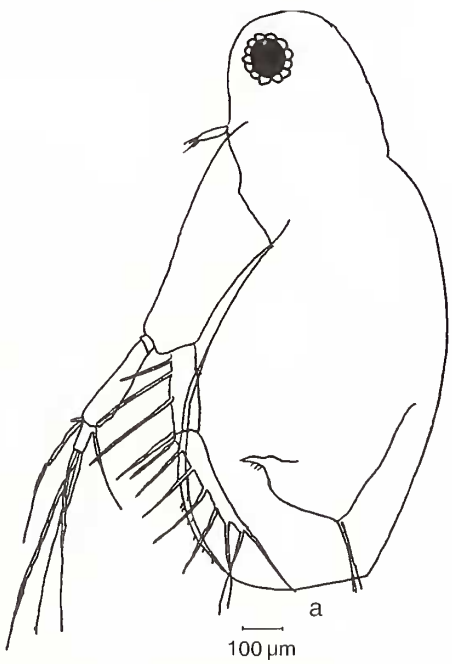

Fig. 12: *Diaphanosoma excisum* (II) Sars
a. Parthenogenetic Female

morphological identity. Both these varieties occurred in the reservoir and in the selected nursery pond. Regarding *M. micrura* (II), there are no records in relevant literature. Dr. Michael in his identification report has commented: "This is a variable species in size, body shape and it needs to be

worked out for India.". *M. micrura* (I) has been extensively recorded in other Indian habitats. In case of the two varieties of *M. micrura*, the supraocular depression is present only in the larger variety. *Diaphanosoma excisum* occurs under two varieties, namely *D. excisum* Sars 1885 (I) and *D. excisum* Sars var. Stingling Jenkin 1934 (II). These two varieties can be distinguished on the basis of length of antenna and serration on the carapace border. Biswas (1971) and Mathew (1977) have reported the Indian occurrence of *D. excisum* Sars 1885 as variety (I). The second variety, *D. exicisum* Sars var. Stingling Jenkin 1934 (II) was reported by Biswas (1971). All the identified Cladocerans occurred both in the reservoir and in the nursery pond, except *Moina dubia* and *Macrothrix laticornis*, which occurred only in the nursery pond.

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22. *AEGINETIA INDICA* ROXB.: A NEW NON-PHOTOSYNTHETIC ANGIOSPERM FOR JAMMU AND KASHMIR FLORA[1]

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During a floristic exploration in the foothills of Jammu in September 2003, the authors collected a specimen of a broomrape with underground parts, growing in a moist and shady habitat, near village Thain of Dayalla Chak, Kathua at an altitude of 600 m above msl. A large population of the species in association with other grasses and *Adiantum* species has been found in this area. The collected specimen has been deposited in the Herbarium, Department of Botany, University of Jammu (Regn. No. SK-HC 1/8248). After a detailed study of the available literature and preserved herbarium collection, the broomrape was identified as *Aeginetia* Roxb. (Fig. 1) of Orobanchaceae – a dicot family.

Perusal of existing literature and collected herbarium sheets implied clearly that this species had not been recorded earlier in Jammu and Kashmir. However, the species has been described by Kehimkar (2000) as a Himalayan species existing between 600-1100 m above msl. A detailed description of this new record to the flora of Jammu and Kashmir is given below:

Aeginetia indica Roxb.

Aeginetia japonica Siebold & Zuccarini; *Orobanche*

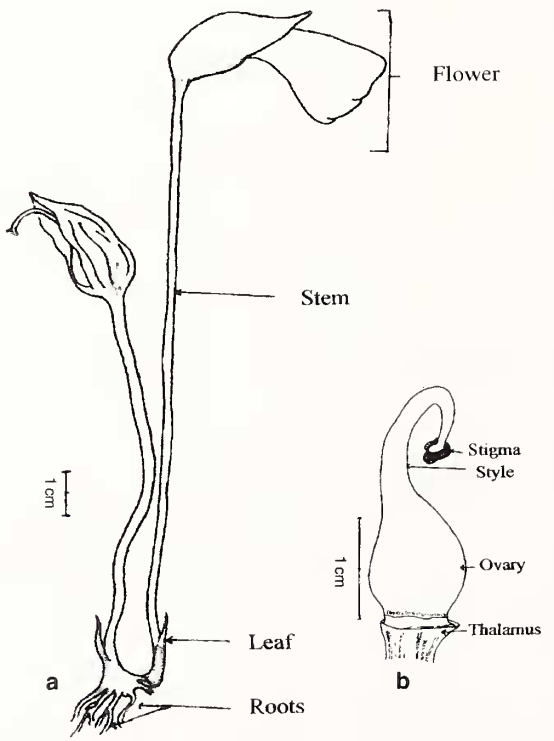

Fig. 1: *Aeginetia indica*: a. Habit; b. Gynoecium